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(54) **Fluorescent colorant donor ribbons for thermal transfer imaging.**

(57) A donor ribbon construction suitable for thermal mass transfer imaging comprises a fluorescent colorant donor layer over-coated or alternated with an opaque white donor layer. Alternative constructions are disclosed in which donor layers containing fluorescent colorant or opaque white background pigments are interspersed alternated, or over-coated on a substrate. A process for transferring a fluorescent colorant image is also disclosed.

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**BACKGROUND OF THE INVENTION**

Fluorescent colorants have been used in printing both as a deterrent to counterfeiting and to provide visually attractive images. When colorants that are fluorescent in the visible region of the electromagnetic spectrum are used, there is difficulty in obtaining good, detailed fluorescent color images when the colorant is printed over a colored background. Under these conditions, fluorescent colorants tend to appear muddy or washed out.

Japanese Published patent application (Kokai) 1-258,990 discloses a thermal transfer donor ribbon coated with heat meltable ink layer regions of 3 primary colors or 4 primary colors plus black and a region containing a fluorescent dye. Overprinting of the respective regions with fluorescent dye is disclosed.

Japanese Published patent application (Kokai) 63-281,890 discloses a recording material having a thermo-fusible ink layer containing a fluorescent compound and a thermo-fusible ink layer containing colorant and a thermo-fusible ink layer containing an extender with hiding power.

U.S. Patent Nos. 4,627,997; 4,866,025; 4,871,714; 4,876,237; and 4,891,352 describe thermal transfer of various fluorescent materials. In preferred embodiments, the fluorescent materials are patch coated on a donor ribbon along with magenta, cyan and yellow ink patches. These patents are directed at colorless fluorescent inks that emit in the visible spectrum upon exposure to ultraviolet radiation.

U.S. Patent 3,647,503 describes a multicolored heat transfer sheet in which colored layers are sequentially coated on a substrate. That patent is directed at multicolored transfer imaging and requires good porosity of the uppermost layer to provide good transfer of dye from lower layers. This is the opposite effect desired in the present invention.

WIPO published patent application number 10268 (1989) discloses a thermal transfer ribbon having a transfer coating including a fluorescent coloring material of a reddish-orange hue in a wax material. The transfer coating contains 50-90% wax, including 20-45% hydrocarbon wax, 35-65% paraffin wax, 2-30% carnauba wax and 2-25% acetate copolymer; 5-20% fluorescent pigment, and 5-20% color toning pigment. No mention is made of using an opaque white background layer to improve image clarity.

U.S. Patent No. 4,472,479 describes an impact ribbon having a layer of fluorescent dye over-coated with a layer of reflective barrier pigment, and an alternate construction wherein the barrier pigment is included within the fluorescent pigment layer. Barrier pigments disclosed in the patent include finely divided reflective materials such as powdered gold and bronze pigments, and powdered aluminum. Opaque dyes and pigments such as titanium dioxide, silica, and alumina are specifically excluded (column 3, lines 33-44) as having a tendency to blend with the fluorescent materials on impact transfer. The use of reflecting barrier pigments is also described in German Patent 3,042,526.

U.S. Patent No. 4,816,344 discloses thermal mass transfer of fluorescent pigments, but makes no mention of using an opaque white pigment layer to provide color clarity.

The present invention overcomes deficiencies of the prior art in providing good quality fluorescent images that are generated by thermal transfer onto colored backgrounds. The clarity of fluorescent images produced by this method is improved by transferring an opaque white pigment layer simultaneous or prior to transfer of the fluorescent pigment layer of the donor ribbon.

**FIELD OF THE INVENTION**

This invention relates to thermal mass transfer imaging. More particularly, this invention relates to transfer of "false color" images using fluorescent pigments.

**SUMMARY OF THE INVENTION**

This invention relates to thermal mass transfer printing, particularly thermal mass transfer printing using fluorescent materials.

It is a feature of the invention to provide high quality fluorescent images by way of a thermal mass transfer process by using a light scattering/light blocking opaque white background layer to enhance and brighten the fluorescent image, especially when the image is placed on top of a colored background. The thermal mass transfer donor ribbons of the invention are suitable for imaging applications in desktop publishing, direct digital non-critical color proofing, and short-run sign manufacture, for example and is especially useful for fluorescent color generation.

In one aspect the invention discloses a fluorescent thermal mass transfer donor ribbon comprising a substrate coated on at least a portion thereof with a fluorescent colorant containing ink layer and another portion or the same portion is coated thereon with an opaque white background ink layer.

In another aspect the invention discloses a process for transfer imaging wherein two layers of material, an opaque white background ink layer and a fluorescent colorant containing ink layer, are thermally transferred in a single step to a receptor film, wherein the resulting thermally transferred fluorescent image is exposed.

5 In yet another aspect the invention discloses a fluorescent thermal mass transfer donor ribbon comprising interspersed patches of a fluorescent colorant containing transfer layer and an opaque white background ink layer.

In a further aspect the invention discloses a process for transfer imaging comprising the steps of thermally transferring an opaque white background ink layer from a donor ribbon to a receptor sheet of film  
10 thereby creating a white background image, and thermally transferring a fluorescent colorant containing ink layer from said donor ribbon onto said white background image.

#### DETAILED DESCRIPTION OF THE INVENTION

15 Two fluorescent thermal mass transfer donor ribbon constructions are useful in the practice of the present invention. In the first embodiment, a thermally transferable layer containing fluorescent colorant is coated onto a substrate, and another thermally transferable layer containing opaque white pigment is over-coated onto the first thermally transferable layer. In the second embodiment, the thermally transferable layers containing opaque white and fluorescent colorants, respectively, are coated in an alternating or  
20 parallel patch-type manner.

According to one embodiment of the present invention, fluorescent thermal mass transfer donor ribbons of the present invention comprise a substrate having coated on at least a portion thereof a fluorescent colorant containing ink layer, wherein said fluorescent colorant containing ink layer is coated thereon with a opaque white background ink layer. In one embodiment of the present invention fluorescent colorant  
25 thermal transfer ribbons are prepared by coating a fluorescent colorant containing ink onto at least a portion of one side of a suitable substrate and coating a opaque white background ink layer onto the exposed fluorescent colorant containing layer. In this embodiment, it is desirable to reduce the thickness of the opaque white background ink layer to facilitate good thermal mass transfer imaging of both the white and fluorescent ink layers. To achieve this, mixtures of titanium dioxide ( $n_d = 2.4$ ) and aluminum oxide ( $n_d = 1.7$ )  
30 are preferably used in the opaque white background ink layer, such that the titanium dioxide and aluminum oxide are dispersed in the opaque white background ink layer. In this way, a high pigment to binder ratio is obtained improving the light scattering ability of the opaque white background layer and permitting the use of thin opaque white background ink layers.

Fluorescent colorant containing ink layers of the present invention comprise a fluorescent colorant and a  
35 binder. Preferably, they are prepared by dispersing colorant in a binder. Opaque white background ink layers comprise a white pigment in a binder. The binder for either of the two embodiments of thermally transferable layers comprises at least one of a wax-like substance and a polymeric resin.

Fluorescent colorants suitable for use in the present invention include organic and inorganic fluorescent dyes and pigments. Non-limiting examples of fluorescent inorganic pigments include zinc sulfide-copper  
40 mixtures, zinc sulfide-copper plus cadmium sulfide-copper mixtures, zinc oxide-zinc mixtures and the like. Non-limiting examples of fluorescent organic pigments include Lumogen L yellow, Lumogen L Brilliant Yellow, Lumogen L Red Orange; A, AX, D, and GT series Day-Glo™ pigments (Day-Glo Corp., Cleveland, OH), and the like. Non-limiting examples of fluorescent dyes include thioflavine (Colour Index (CI) 49005); Basic Yellow BG (CI 46040); Fluorescein (CI 45350); Rhodamine B (CI 45170); Rhodamine 6G (CI 45160);  
45 Eosin (CI 45380); and conventional white fluorescent brighteners such as, for instance, as CI fluorescent Brightening Agent 85, 166 and 174, fluorescent colorants may be those obtained by rendering the above mentioned fluorescent dyes oil soluble (and simultaneously water insoluble) with organic acids such, for instance, as Oil Pink #312 obtained by rendering Rhodamine B oil soluble and Barifast Red 1308 obtained by rendering Rhodamine 6G oil soluble (produced by Orient Chemical Co.). Fluorescent colorants may also  
50 be obtained by lake formation of the above fluorescent dyes with metal salts and other precipitants such as, Fast Rose and fast Rose Conc obtained by lake formation of Rhodamine 6G (produced by Dainichi Seika Kogyo K.K.), and so forth.

Although the present invention may be employed with ultraviolet or infrared fluorescing colorants, it is preferred that the fluorescent colorants of the present invention should have fluorescence emission in the  
55 wavelength range of 350 to 700 nm, more preferably in the range of 400 to 650 nm.

Suitable white pigments include, but are not limited to, white metal oxides such as titanium dioxide, zinc oxide, aluminum oxide and hydroxide, magnesium oxide, etc.; white metal sulfates such as barium sulfate, zinc sulfate, calcium sulfate, etc., and white metal carbonates such as calcium carbonate, etc. For optimal

stability and operability of the present invention and the images formed thereby the white pigments should have very low solubility in water. The white pigments may be optionally treated with surface modifying agents to improve their dispersibility in the binder.

Suitable wax-like substances have a melting point or softening point of from about 50° to 140° C, and include but are not limited to higher fatty acid ethanolamines such as stearic acid monoethanolamide, lauric acid monoethanolamide, coconut oil monoethanolamide; higher fatty acid esters such as sorbitan higher fatty acid esters such as sorbitan behenic acid ester; glycerine higher fatty acid esters such as glycerine monostearic acid ester, acylated sorbitols such as acetylsorbitol and benzoylsorbitol, acylated mannitols such as acetylmannitol; and waxes such as beeswax, paraffin wax, carnauba wax, Chlorez™ waxes, etc.; and mixtures thereof. Preferred wax-like materials include stearic acid monoethanolamide (mp 91°-95° C), lauric acid monoethanolamide (mp 80°-84° C), coconut oil fatty acid monoethanolamide (mp 67°-71° C), sorbitan behenic acid ester (mp 68.5° C), sorbitan stearic acid ester (mp 51° C), glycerine monostearic acid ester (mp 63° - 68° C), acetyl sorbitol (mp 99.5° C), benzoyl sorbitol (mp 129° C), and acetyl mannitol (mp 119°-120° C).

Suitable polymeric resins have melting or softening points in the range of about 20° to 180° C, preferably in the range of 40° to 140° C, more preferably in the range of 55° to 120° C, and most preferably in the range of 60° to 100° C and include, but are not limited to, polycaprolactone, polyethylene glycols, aromatic sulfonamide resins, acrylic resins, polyamide resins, polyvinyl chloride and chlorinated polyvinyl chloride resins, vinyl chloride-vinyl acetate copolymers, alkyd resins, urea resins, melamine resins, polycylolefins, benzoguanamine resins and copolycondensates or copolymers of the above resin materials. Preferred polymeric resins are polycaprolactones having an average molecular weight of 10,000 g/mol (mp 60°-65° C) polyethylene glycols having an average molecular weight of 6000 g/mol (mp ~ 62° C), low condensation polymerized melamine toluenesulfonamide resins (sp ~ 105° C), low condensation polymerized benzyltoluene sulfonamide resins (sp ~ 68° C), acrylic resins (sp ~ 85° C), and linear polyamide resins (sp ~ 60° C). The terms "mp" and "sp" refer to "melting point" and "softening point," respectively.

Preferably, the fluorescent colorant containing ink layer and opaque white background ink layer have a melting point (mp) or softening point (sp) of 50°-140° C to enhance the thermal transferring property.

Suitable substrate materials for the thermal mass transfer donor element may be any flexible material to which a fluorescent colorant containing ink layer may be adhered. Suitable substrates may be smooth or rough, transparent, opaque, and continuous or sheet-like. They may be essentially non-porous. Preferred backings are white-filled or transparent polyethylene terephthalate or opaque paper. Non-limiting examples of materials that are suitable for use as a substrate include polyesters, especially polyethylene terephthalate, polyethylene naphthalate, polysulfones, polystyrenes, polycarbonates, polyimides, polyamides, cellulose esters, such as cellulose acetate and cellulose butyrate, polyvinyl chlorides and derivatives, etc. The substrate generally has a thickness of 1 to 500 μm, preferably 2 to 100 μm, more preferably 3 to 10 μm.

By "non-porous" in the description of the invention it is meant that ink, paints and other liquid coloring media will not readily flow through the substrate (e.g., less than 0.05 ml per second at 7 torr applied vacuum, preferably less than 0.02 ml per second at 7 torr applied vacuum). The lack of significant porosity prevents absorption of the heated receptor layer into the substrate.

In another embodiment of the present invention fluorescent thermal mass transfer ribbons are prepared by coating a fluorescent colorant containing ink layer and an opaque white background ink layer onto one side of a suitable substrate in a pattern such that the two ink layers are interspersed in a manner so that the area of the substrate covered by each ink layer is substantially equal. The white and the fluorescent image may be identical (coextensive in all direction), substantially overlap, completely overlap, outline one another, or border each other.

The fluorescent thermal mass transfer ribbons of the present invention are generally employed in combination with a receptor sheet in a process for transfer imaging wherein two layers of material, an opaque white background ink layer and a fluorescent colorant containing ink layer, are transferred in a single step or sequential steps.

The fluorescent thermal transfer donor ribbons of the invention are suitable for image production in desktop publishing, direct digital non-critical color proofing, short run sign manufacture, and so forth, especially for graphics desiring fluorescent color generation.

Coating of the thermally transferable layers on the donor sheets may be accomplished by many standard web coating techniques such as imprint gravure, single or double slot extrusion coating, and the like. Imprint gravure is particularly useful for patch-type coatings in which there are interspersed regions of opaque white and fluorescent colorants on a ribbon or sheet. Layer coating thicknesses useful in the present invention are 0.1 to 50 μm, preferably 0.5 to 10 μm, most preferably 1 to 6 μm.

The donor ribbons of the present invention are generally used in thermal printing by contacting the transferable layer of the donor ribbon with a receptor sheet or film such that at least one thermally transferable donor layer is in contact with the receptor sheet. Heat is applied, either from a thermal stylus or an infrared heat source such as an infrared laser or a heat lamp and the donor layer is transferred to the receptor. The heat may be applied to the back of either the donor ribbon or receptor sheet or may be directly introduced to a transferable donor layer.

Preferred receptor sheet materials are Dai Nippon Type I and Type V receptor films (Dai Nippon Insatsu K.K., Tokyo, Japan), Dupont 4-Cast™ receptor film (E.I. Dupont de Nemours Co., Wilmington, DE), Scotchcal film (3M Co., St. Paul, MN), and polyethylene terephthalate. The receptor sheets may be colored, that is they may have an optical density of at least 0.2 in the visible region of the electromagnetic spectrum.

In a preferred embodiment a release coating is applied to the back side of the donor ribbon (i.e., the side opposite the thermally transferable donor layer(s)) to improve handling characteristics of the ribbon and reduce friction. Suitable release materials include, but are not limited to, silicone materials including poly-(lower alkyl)siloxanes such as polydimethylsiloxane and silicone-urea copolymers, and perfluorinated compounds such as perfluoropolyethers.

The following examples further illustrate practice of the present invention and should not be considered limiting.

#### COMPARATIVE EXAMPLE

This comparative example demonstrates the preparation of a fluorescent colorant donor ribbon and formation of fluorescent images on various receptor films by thermal transfer.

A solution of fluorescent pigment consisting of 9 parts GT series Aurora Pink pigment (Day-Glo Corp., Cleveland, OH), 9 parts Chlorowax™ 70 (a chlorinated paraffin wax, mp 102° C, obtained from Occidental Petroleum Co., Irving, TX), and 1 part Acryloid™ B82 (an acrylic resin,  $T_g = 35^\circ \text{C}$ , obtained from Rohm and Haas, Philadelphia, PA) was mixed in a ball mill for 10-15 hr. Then 7.5 parts of a beeswax solution in toluene added with mixing to give a coating solution that was 30% solids in toluene. The resultant solution was coated approximately 5  $\mu\text{m}$  thick onto 6  $\mu\text{m}$  polyethylene terephthalate (PET) film. This coat was dried for approximately 2 minutes at 70° C.

Thermal transfer of this film was demonstrated with four receptor materials: (a) Scotchcal™ film (3M Co., St. Paul, MN) at approximately 1.6 J/cm<sup>2</sup> using a thermal printer capable of 200 dot per inch (dpi) resolution. The resultant transferred image had slightly uneven edges on the dots at 200 dpi resolution; (b) 76  $\mu\text{m}$  PET film (at approximately 1.6 J/cm<sup>2</sup> using the same thermal printer as in (a), a resolution of 200 dpi for the transferred image although dots at 200 dpi were slightly uneven; (c) Type I and Type V Dai Nippon dye transfer receptors (Dai Nippon Insatsu K.K., Tokyo, Japan) at approximately 1.6 J/cm<sup>2</sup> using the same thermal printer as in (a), transferred dot images at 200 dpi were slightly uneven.

It was visually noted that the transferred fluorescent pigment images lost much of their fluorescence when coated over a non-white background.

#### EXAMPLE 1

This example demonstrates the preparation of a fluorescent pigment donor ribbon construction consisting of a substrate coated sequentially with fluorescent pigment containing layer and an opaque white layer.

A fluorescent pigment solution was mixed as in the Comparative Example. It was coated approximately 3  $\mu\text{m}$  thick onto 6  $\mu\text{m}$  PET. It was dried approximately 3 minutes at 70° C. Then a solution of 8 parts TiO<sub>2</sub> (average particle size < 100 nm), 1 part Acryloid™ B-82 (an acrylic resin,  $T_g = 35^\circ \text{C}$ , obtained from Rohm and Haas, Philadelphia, PA), and 1 part DeSoto E-335™ (an acrylic resin from DeSoto Inc., Des Plaines, IL) was ground in a ball mill for 5-10 hours. Then 3 parts beeswax in toluene was added with mixing. This solution (30 wt% in solids in toluene) was coated approximately 2  $\mu\text{m}$  thick over the fluorescent layer. This entire film was dried 3 minutes at 70° C.

This film was printed onto the Dai Nippon dye Type I transfer receptor sheet at approximately 1.6 J/cm<sup>2</sup> using the thermal printer of the Comparative Example at a resolution of 200 dpi.

The resultant transferred fluorescent image was visually determined to have improved color clarity compared to the images in the Comparative Example.

## EXAMPLE 2

This example demonstrates an alternate printing method in which an opaque white layer is printed and then overprinted with fluorescent material.

5 A solution of fluorescent pigment was mixed as in the Comparative Example. This solution was coated out at approximately 5  $\mu\text{m}$  onto 6  $\mu\text{m}$  PET film. This film was dried 3 minutes at 70° C.

Another mixture of 8 parts  $\text{TiO}_2$  (average particle size < 100 nm) and 2 parts DeSoto E-338™ (an acrylic resin, obtained from DeSoto Inc., Des Plaines, IL) was mixed in a ball mill for 8-10 hours. Then 3 parts beeswax solution in toluene was added with mixing. This solution (30 wt% solids in toluene) was  
10 coated at 4.5  $\mu\text{m}$  onto another 6  $\mu\text{m}$  PET film. This film was dried 3 minutes at 70° C. First the white layer was printed onto a Dai Nippon Type I receptor sheet, followed by over-printing of the fluorescent pigment layer. Both transfer steps were performed at approximately 1.6 J/cm<sup>2</sup> using the thermal printer of the Comparative Example at a resolution of 200 dpi.

It was visually determined that the fluorescence was much better with the white layer than without it.

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## EXAMPLE 3

This example demonstrates a two layer construction wherein an opaque white background ink layer is coated on a fluorescent colorant containing ink layer supported by a substrate.

20 Two dispersions, one opaque white and one fluorescent, were prepared and dispersed as 30 wt% solids in 9:1 toluene/butyl acetate solvent. The fluorescent solution consisted of 4 parts AX series Aurora Pink (Day-Glo Corp., Cleveland, OH) and 1 part Acryloid B-66 (an acrylic resin,  $T_g$  = 50° C, Rohm and Haas, Philadelphia, PA). The opaque white dispersion was prepared by combining 6 parts titanium dioxide (sub-micron average particle diameter), 2 parts Space Rite S-11 alumina (a 0.25-0.3  $\mu\text{m}$  average particle size  
25 aluminum trihydrate, Alcoa Corp., Bauxite, AR), 1 part Elvacite™ 2008 (an acrylic resin,  $T_g$  = 105° C, obtained from E.I. DuPont de Nemours Co., Wilmington, DE), and 0.5 parts EHEC low (an ethyl hydrox-yethyl cellulose with extra low viscosity, flow temperature > 175° C, obtained from Dow Chemical Co., Midland, MI). Each dispersion was independently mixed in a ball mill for 6 to 10 hr.

The fluorescent layer was coated onto 6  $\mu\text{m}$  polyethylene terephthalate film at 8.33  $\mu\text{m}$  wet thickness  
30 using a number 5 Meyer bar (R&D Specialties, Webster, NY). The coating was air dried for 2 minutes then the opaque white layer was coated on top of the fluorescent layer at a 5  $\mu\text{m}$  wet thickness using a number 3 Meyer bar. The coated film was oven dried for about 2 min at 70° C.

Image transfer was accomplished using the thermal printer of the Comparative Example wherein the opaque white and fluorescent layer were transferred simultaneously using a thermal energy of 3.8 J/cm<sup>2</sup>.  
35 The fluorescent image had good color clarity as judged by eye and a resolution of at least 200 dpi.

## EXAMPLE 4

This example demonstrates a patch-type coating construction. Fluorescent dispersions in toluene were  
40 prepared according to the method of the Comparative Example in amounts described in Table 1, and alternately coated with an opaque white dispersion according the method of Example 5 in amounts described in Table 1 onto 6  $\mu\text{m}$  thick, 9 inch wide polyethylene terephthalate film in 13 inch long patches and oven dried two to 3 minutes at 60 to 80° C. The thermally transferable fluorescent films thus prepared were imaged onto Dai Nippon Type V receptor film using the thermal printer of the Comparative Example 1.

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Table 1

Fluorescent Patch-Type Thermal Transfer Printing			
Fluorescent Layer Composition White Background Layer Composition	Thickness ( $\mu\text{m}$ )	$\Delta$ Energy ( $\text{J}/\text{cm}^2$ )	Overall Image Quality
GT-11/CI-wax 70/B-82 (9/9/1) TiO <sub>2</sub> /CI-wax 70/B-82 (9/9/1)	5.5 5.5	2.43	good to fair
GT-11/CI-wax 70/B-82/B44S (9/9/1/1) TiO <sub>2</sub> /E-333/E-337 (8/1/1)	5.5 5.5	2.43	very good
GT-11/B-82/CI-wax 70 (8/2/2) TiO <sub>2</sub> /E-333/E-337 (8/1/1)	5.5 5.5	2.75	fair to good
GT-11/CI-wax 70/B-82/C-10LV/Elvax™ (9/9/1/5/5) TiO <sub>2</sub> /E-333/E-337 (8/1/1)	5.5 5.5	3.43	very good
GT-11/CI-wax 70/B-82/C-10LV/Elvax™ (9/5/5/2/1) TiO <sub>2</sub> /E-333/E-337 (8/1/1)	5.5 5.5	3.43	good
GT-11/CI-wax 70/E-337/Elvax™ (9/5/3/1) TiO <sub>2</sub> /E-333/E-337 (8/1/1)	5.5 5.5	2.43	good
A-19/CI-wax 70/E-337/Elvax™ (9/5/3/1) TiO <sub>2</sub> /E-333/E-337/Elvax™ (8/1/1/5)	5.6 5.5	2.43	good resolution
GT-11/CI-wax 70/E-337/Elvax™ (9/5/3/1) TiO <sub>2</sub> /E-333/E-337/Elvax™ (8/1/1/5)	5.6 5.5	2.43	good resolution
GT-11 (Aurora Pink, Day-Glo Corp.), A-19 (Horizon Blue, Day-Glo Corp.), CI-wax 70 (Chlorowax™ 70, Occidental Chemical Co.), B-82 (Acryloid B82, Rohm and Haas), B-44S (Acryloid™ B44S, Rohm and Haas), E-333 (modified acrylic resin E-333, DeSoto			

## EXAMPLE 5

A sample of 5 parts titanium dioxide (sub-micron average particle diameter) 3 parts Space Rite S-11 alumina (a 0.25-0.3 $\mu\text{m}$  average particle size aluminum trihydrate), 3 parts Carboset XL-11 (an acrylic resin,  $T_g = 55^\circ\text{C}$ , obtained from B.F. Goodrich Company, Cleveland, OH) and 2 parts Cab-o-Sil MS (an amorphous fumed silica, Cabot Corporation, Tuscola, IL) was dispersed 30% in isopropyl alcohol by milling in a ball mill for 6-10 hours.

Another sample of 8 parts AX series Aurora Pink (Day-Glo Corp., Cleveland, OH), 1 parts Carboset XL-11 (an acrylic resin,  $T_g = 55^\circ\text{C}$ , B.F. Goodrich Co., Goodrich Company, Cleveland, OH) was dispersed 30% in isopropyl alcohol by high-speed (propellor) mixing for 10 minutes.

The fluorescent layer was coated onto 6 $\mu\text{m}$  PET film at 8.33  $\mu\text{m}$  wet thickness using a number 5 Meyer Bar (R&D Specialties, Webster, NY). The coating was air dried for 3 minutes, then the opaque layer was coated on top of the fluorescent layer at a 5  $\mu\text{m}$  wet thickness using a number 3 Meyer bar. The film was oven dried for about 5 minutes at  $70^\circ\text{C}$ .

Image transfer was accomplished using the thermal printer of the Comparative Example wherein the opaque white and fluorescent layer were transferred simultaneously using a thermal energy of 3.8  $\text{J}/\text{cm}^2$ . The fluorescent image had good color clarity as judged by eye and a resolution of at least 200 dpi.

## Claims

1. A thermal mass transfer donor element comprising a substrate having coated thereon a thermally transferrable fluorescent colorant and a thermally transferable opaque white material.
2. The donor element of claim 1 wherein said fluorescent colorant comprises a layer on said substrate and said opaque white material comprises a layer overcoated on said fluorescent colorant.

3. The donor element of claim 1 wherein said fluorescent colorant comprises patches of colorant on said substrate and said opaque white material comprises patches of colorant on areas of said substrate where said fluorescent colorant is not present.
- 5 4. The donor element of claims 1, 2 or 3 wherein said opaque white material comprises white metal oxides, white metal sulfates, or white metal carbonates.
5. The donor element of claims 1, 2 or 3 wherein said opaque white material is mixed with a wax or polymeric resin.
- 10 6. The donor element of claim 4 wherein said opaque white material is mixed with a wax or polymeric resin.
7. A process for providing a fluorescent image on a receptor surface comprising thermal mass transferring a white image onto a receptor surface and thermal mass transferring on top of at least part of said white image a fluorescent image.
- 15 8. The process of claim 7 wherein said transferring of said white image and said fluorescent image are performed at the same time.
- 20 9. The process of claim 7 wherein said transferring of said white image and said fluorescent images are performed sequentially.
10. The process of claim 7 wherein said white image and said fluorescent image substantially overlap, and said white image and said fluorescent image are substantially the same.
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European Patent  
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# EUROPEAN SEARCH REPORT

Application Number

EP 92 30 7718

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	EP-A-0 208 385 (CANON K.K.) * page 17, line 15 - line 22; figure 1 * * page 8, line 9 - line 15 * * page 34, line 26 - page 35, line 17 * * page 39, line 6 - line 25 * ---	1-10	B41M5/38 B41M5/40
X	EP-A-0 313 355 (CANON K.K.) * column 8, line 15 - column 9, line 21; figure 1 * ---	1-10	
X,D	WO-A-8 910 268 (NCR CORPORATION) * page 2, line 25 - page 3, line 3; claims 6,10 * ---	1,4-6	
A,D	* page 9; table 2 * * page 13, line 28 * * page 13, line 33 * ---	2-3,7-10	
A	EP-A-0 368 551 (IMPERIAL CHEMICAL INDUSTRIES PLC) * page 3, line 8 - line 11 * * page 3, line 32 - line 37; claim 1 * -----	3	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B41M
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 06 JANUARY 1993	Examiner BACON A.J.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- A : member of the same patent family, corresponding document	